Be-10 evidence for a paleo-subglacial lake and subsequent deglaciation processes in Pine Island Bay, West Antarctica

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Abstract

Reconstruction of the glacial dynamics of the Antarctic ice sheets during the past by studying records from their margin is essential to evaluate their stability and to anticipate their contribution to future sea level rise. Recently, the first direct evidence for a paleo-subglacial lake on the Antarctic continental shelf was reported from a small bedrock basin in Pine Island Bay, West Antarctica (Kuhn et al., 2017). The evidence is based on a distinct sediment facies and geochemical pore water signatures, i.e. low chloride concentrations, in a marine sediment core (PS69/288). These data indicate that the sediment in the lower part of the core was deposited under a low-energy subglacial lake setting. They also show that the location of the subglacial lake is consistent with the predicted distribution of subglacial lakes based on bathymetric data. Here we report further evidence for a paleo-subglacial lake based on changes in Be-10 concentrations in the sediments. A significant down-core decrease in the Be-10 concentration indicates very limited input of meteoric Be-10 to the sediments in the lower part of the core, suggesting a depositional environment that was isolated from the open ocean. This is consistent with the proposed subglacial lake setting. In detail, the Be-10 concentration shows a further drop within a sand, silt and mud interval from ca. 580 to 470 cm core depth that was interpreted to have been deposited during the transition from the subglacial lake to a sub-ice shelf cavern by grounding line retreat in that area at about 11 kyrs B.P. (Hillenbrand et al., 2013, Kuhn et al., 2017). The lowered Be-10 concentration at the base of this interval probably results from the dominant supply of sediment that had been deeply buried under the West Antarctic Ice Sheet (WAIS) for a very long time. Above a minor up-core increase from 464 to 324 cm, the Be-10 concentration decreases again at about 260 cm. This decrease may correspond to three possible factors: 1.) increased supply of sediments from below the ice sheet (possible meltwater plumes), 2.) an episode of permanent sea-ice cover, or 3.) a re-advance of the ice shelf. Above 260 cm the Be-10 concentration increases significantly toward the top of the core, indicating that an open marine setting had established at the core site. This data provides new insight into a more dynamic behaviour of the WAIS in Pine Island Bay during the Holocene. Overall, the Be-10 concentration of the sediments is a powerful tool to study paleo-subglacial lakes in Antarctica and processes of ice sheet to ice shelf transition during the subsequent deglaciation.

Keywords: Subglacial Lake, Be-10, Ice sheet retreat, West Antarctica

References

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